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COMPARATIVE OBSERVATIONS WITH FRIEZ-TYPE RADIOSONDES AND FERGUSSON METEOROGRAPHS

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[U. S. Weather Bureau, Washington, September, 1942]

For the purpose of obtaining comparative data on the performance of the two types of instruments, a Fergusson meteorograph was attached to each radiosonde released at Omaha, Nebraska, during the two periods October 19–November 2, 1939, and February 13–23, 1940, inclusive. The observations during the first period were begun at approximately 0245 E. S. T., and those for the second period at about 0145 E. S. T.

The radiosondes, weighing approximately 1,100 grams, were of the modulated audio-frequency type manufactured by J. P. Friez & Sons. The Fergussons, weighing approximately 300 grams, had the records imprinted on smoked aluminum sheets.

The assembled outfit was comprised of the following: A 700-gram balloon, a 72- by 72-inch red silk parachute fastened 6 inches below the neck of the balloon, a drag balloon inserted in the ring of the parachute, and a Fergusson approximately 15 feet below the radiosonde.

Twenty-seven meteorographs were released during these two periods and twenty-two usable records were obtained. One record was lost due to the clock stopping, another due to the instrument hitting the side of the building at release, and a third record was obliterated. Two of the instruments have not been returned to date.

The radiosonde records were evaluated while the observations were in progress. However, the Fergussons had to be returned by their finders before the data could be computed and comparisons made. When the evaluated record of one of the instruments failed to show a significant level shown by the other, the original record of the one not showing the change was rechecked to determine whether a significant level had been omitted in the evaluation.

Corresponding records were plotted on the same adiabatic chart so that comparisons could readily be made. Realizing that the surface level might not be a suitable locking point as far as pressure values were concerned, a locking point was selected at some significant level soon after release. Because of this fact, some of the radiosonde records were displaced in pressure, although later investigation showed that due to a slight shift in pressure at release on some of the Fergussons it might have been better in most cases to displace the Fergusson pressures. However, for comparative purposes, as long as the displacement was small it made little difference which curve was displaced. This action was considered justified in view of the shift in the Fergusson pressure trace just mentioned and also the fact that the error in the radiosonde release pressure setting might be as much as 3 or 4 millibars. There was no good reason for locking the

temperature curves at any point other than the surface and, therefore, this was not done in any case. On 7 days the records were plotted without any displacement whatever. However, on the remaining 15 observations, a displacement varying from 3 to 21 millibars was necessary. The radiosonde pressure values were decreased an average of 12 mb. on 13 days and increased an average of 6 mb. on 2 days.

Figures 1 and 2 show the daily departures of the radiosonde temperatures from those recorded by the meteorographs. In plotting these curves, the temperature differences were noted for significant levels and plotted at the corresponding Fergusson pressures, unless the latter were believed to be erroneous.

In figure 1 it will be noted that there is a concentration of the curves between the one degree lines on either side of the Fergusson. All of the significant points, with the exception of two, are within the 2° lines. In figure 2 practically all points lie within the range from +1.5° C. to -2.0° C., with a significant grouping of the curves near the -1° C. line.

Figures 3 and 4 show average departures of the radiosonde temperatures from those recorded by the Fergussons. In the October–November 1939 series, there is a tendency for the average radiosonde temperatures in the lower levels to be nearly equal to or slightly higher than those of the Fergusson. However, from 700 to 250 mb. the trend is for the radiosonde to become lower and continue lower throughout the remainder of the observation. In the February 1940 series, the average temperatures in the lower levels are also nearly identical. The radiosonde then shows a tendency to be higher than the Fergusson between 750 and 500 mb. From 500 to 300 mb. the radiosonde averages slightly lower, and from 300 to 80 mb. the two temperatures again are nearly identical. Above 80 mb. the radiosonde becomes somewhat higher than the Fergusson. The average curve for the two seasons shows that at pressures greater than 600 mb. there is very little difference between the temperatures recorded by the two instruments. For pressures less than 600 mb. the radiosonde temperatures average slightly lower than those of the Fergusson except near the top of the curve which is based on only one observation.

Figure 5 shows the temperature-pressure comparisons between the two instruments for eight selected observations. The radiosonde pressures for observations 2, 4, and 8 were not displaced. The radiosonde pressures for observation 1 were decreased 12 mb. for locking purposes; those for observations 3 and 5 were decreased 6 mb.; observation 6 increased 7 mb.; and, observation 7 decreased

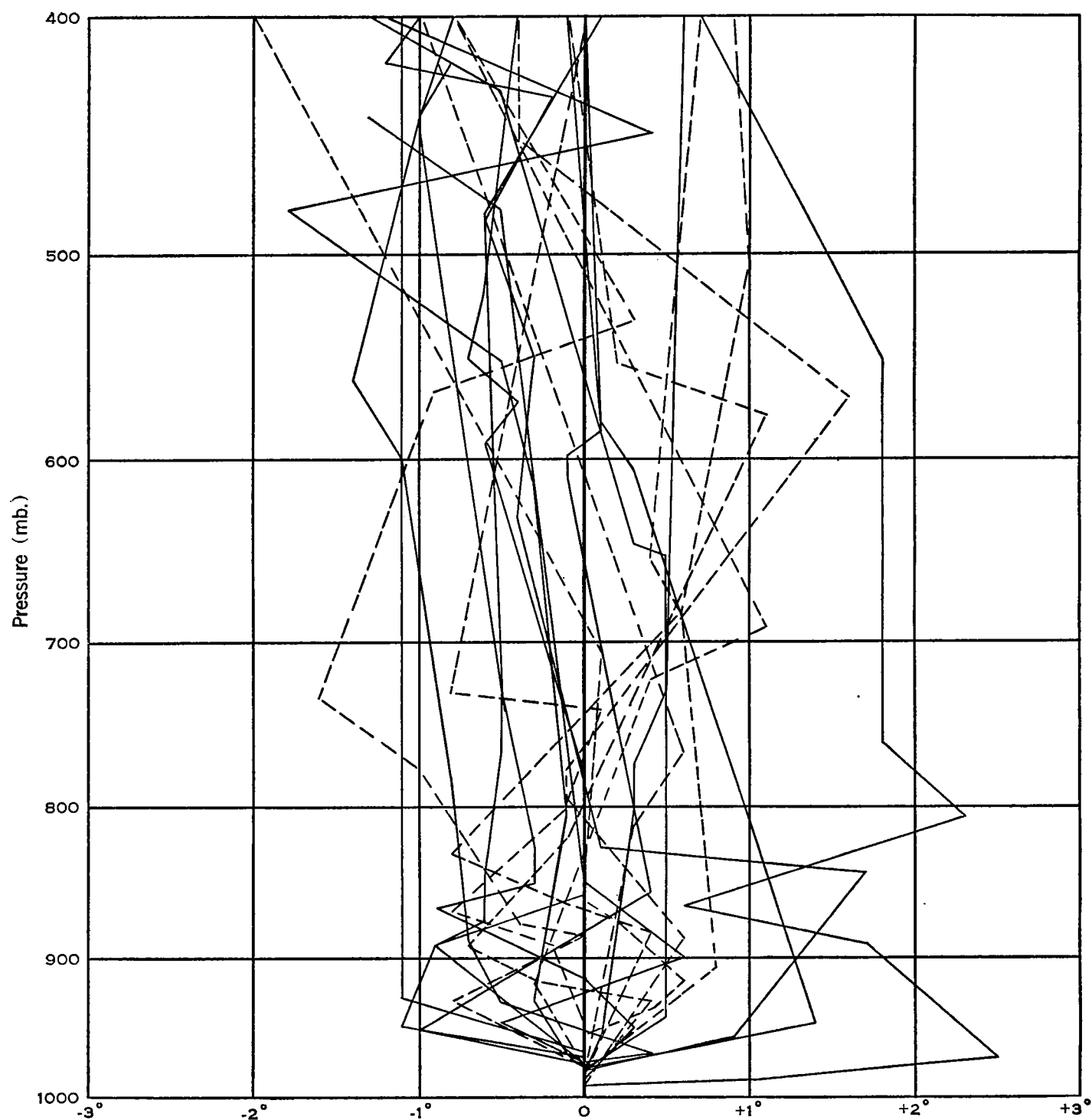


FIGURE 1.—Departures (in °C.) of radiosonde temperatures from Fergusson meteorograph temperatures. Heavy vertical line, Fergusson meteorograph record; full line, records made during October-November 1939; dashed line, records made during February, 1940.

20 mb. These 8 records were selected for the following reasons:

No. 1. In this case the Fergusson record was returned by the finder more than 2 years after being released. The record was good except for the upper portion, which was obliterated.

No. 2. Selected as the one outstanding example of the one instrument showing an inversion not recorded by the other. (See records between 842 and 826 mb.)

Nos. 3 and 4. Selected as being the worst two comparisons of the 22 observations.

Nos. 5 and 6. Selected as representing the average comparisons.

Nos. 7 and 8. Selected as representing the best two comparisons.

Of the 21 relative humidity comparisons obtained, 11 showed good agreement (i. e., practically the entire record within 10 percent), 9 were fair and 1 was poor due to the Fergusson trace sticking. (See No. 3 in figure 6.) In the case of the 9 fair comparisons, the trends were almost identical, but the magnitudes differed. In 5 of the 9 cases, the Fergussons showed greater range, while in 3 cases the radiosondes had the greater range. In another case the radiosonde range was greater at high humidities and the Fergusson range greater at low humidities. However, this latter case is not a characteristic behavior of the two instruments.

Figure 6 shows the relative humidity comparisons between the two instruments for the same observations as in figure 5, except that no comparison is available for observation No. 2 (made on October 23, 1939). These records are believed to be fairly representative of all the observations.

It is extremely difficult to make good flight comparisons between the pressures of the two instruments. The necessity for a displacement of some of the pressure curves has been pointed out. Generally, after the displacement was made and a good locking point obtained, there was very good agreement between the pressures recorded by the two instruments, i. e., within 10 mb. or less, with an occasional difference of as much as 20 or 25 mb. in the lower levels. A notable exception was the comparison made on February 19, 1940. In this case the Fergusson pressure calibration apparently changed between the time of calibration and release. The pressure element expanded too much in flight and as a result all pressures appear to be too low (approximately 70 mb. difference at the top of the observation).

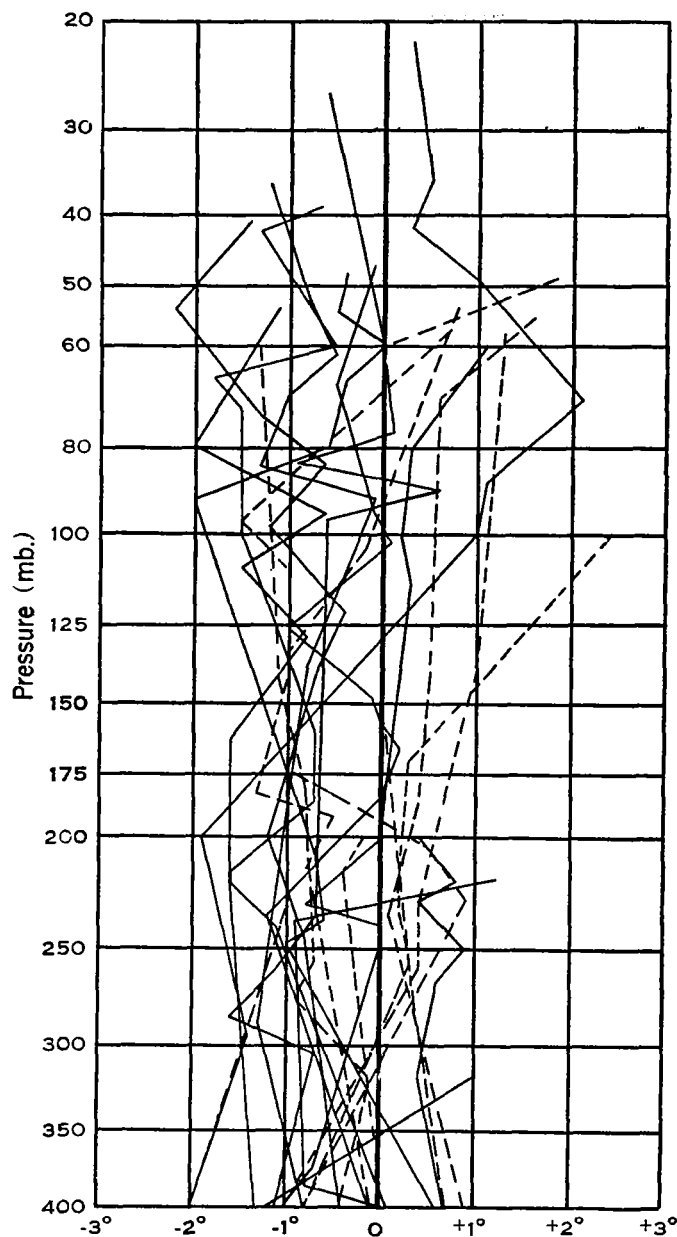


FIGURE 2.—Departures (in °C.) of radiosonde temperatures from Fergusson meteorograph temperatures. Heavy vertical line, Fergusson meteorograph record; full line, records during October–November 1939; dashed line, record during February 1940.

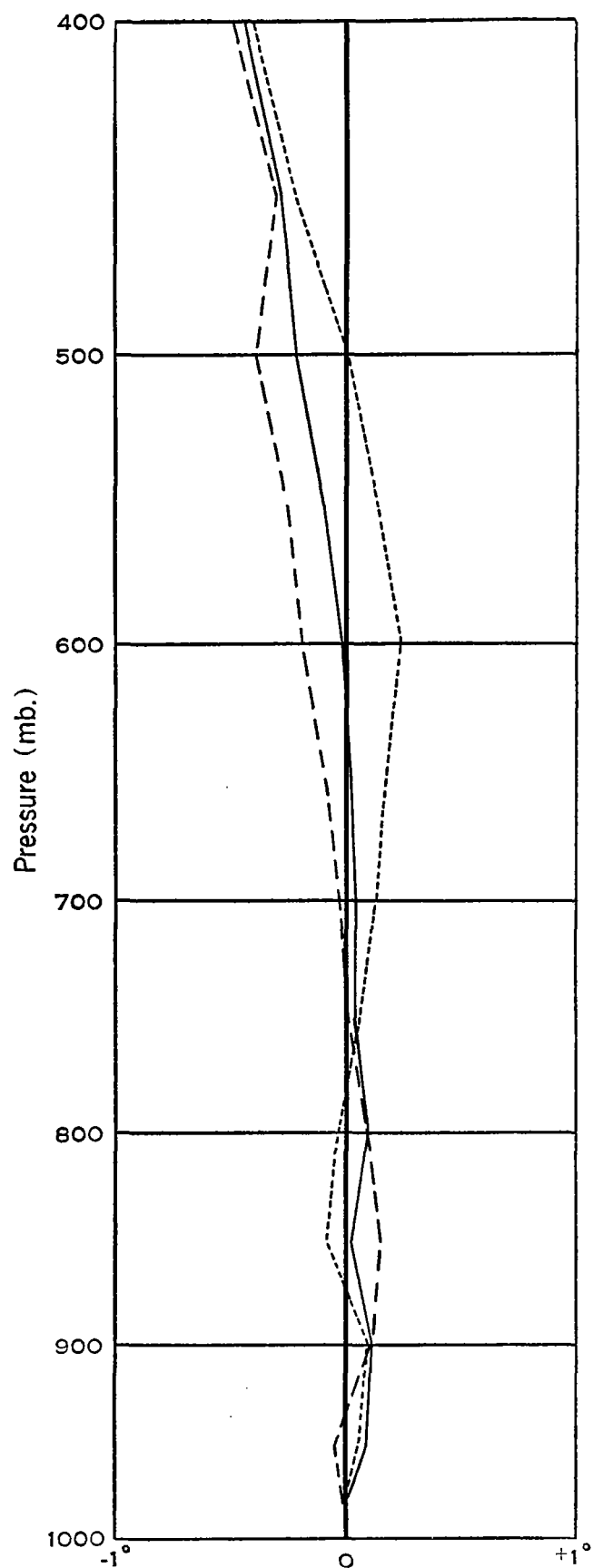


FIGURE 3.—Average departures (in °C.) of radiosonde temperatures from Fergusson meteorograph temperatures. Heavy vertical line, Fergusson meteorograph record; full line, October-November 1939 and February 1940; long dashed line, October-November 1939; short dashed line, February 1940.

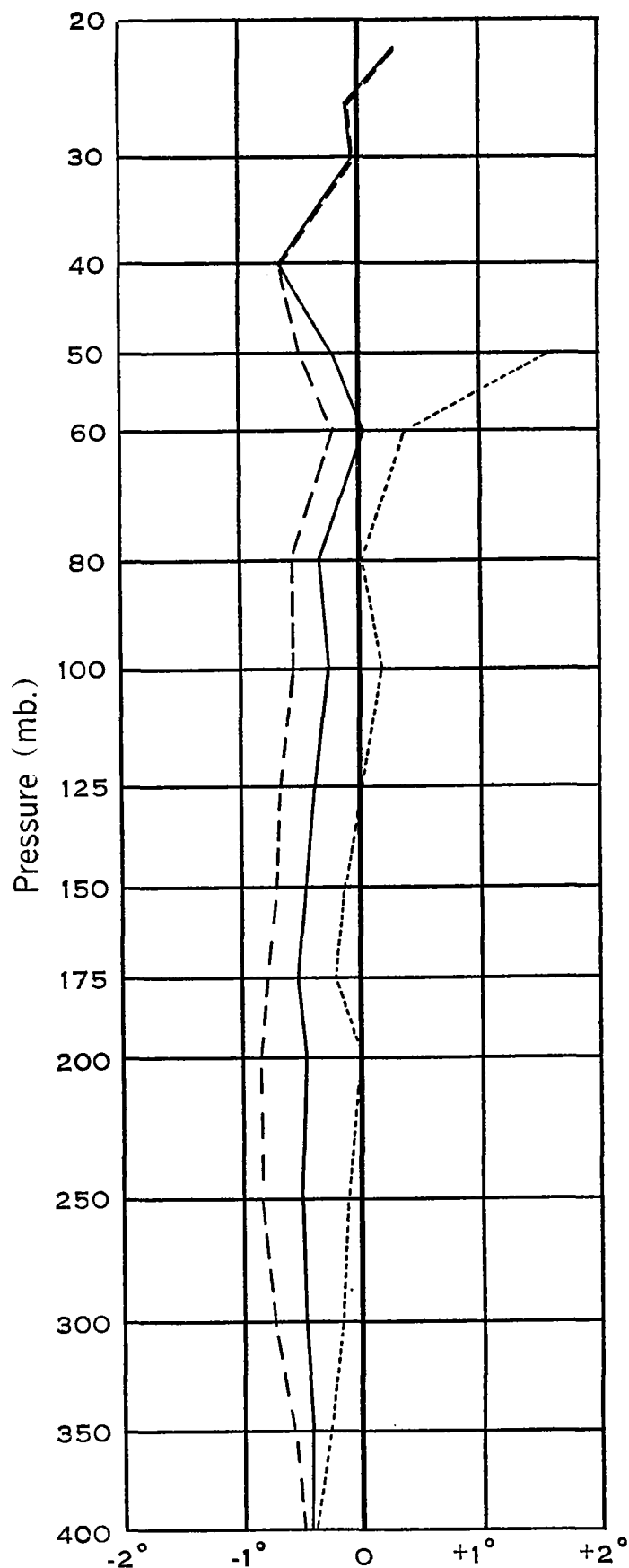


FIGURE 4.—Average departures (in °C.) of radiosonde temperatures from Fergusson meteorograph temperatures. Heavy vertical line, Fergusson meteorograph record; full line, October-November 1939 and February 1940; long dashed line, October-November 1939; short dashed line, February 1940.

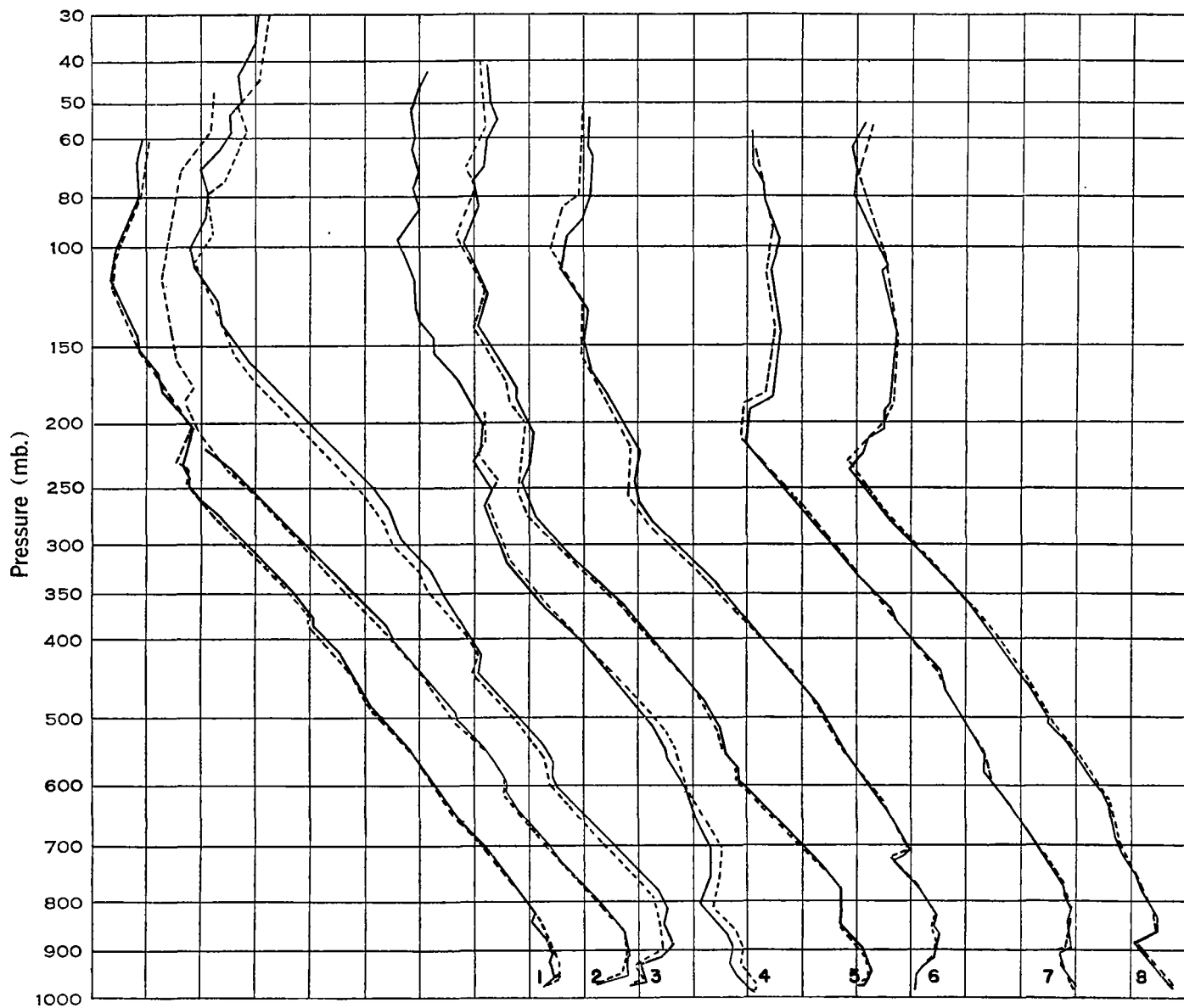


FIGURE 5.—Temperature-Pressure comparisons between the radiosonde and Fergusson meteorographs for selected observations. Full lines, Fergusson meteorograph records; dashed lines, radiosonde records; abscissa interval is 10° C.

¹ Instruments released on October 19, 1939, at 0250 E. S. T., release temperature= 12.2° C.

² Instruments released on October 23, 1939, at 0242 E. S. T., release temperature= 12.1° C.

³ Instruments released on October 26, 1939, at 0245 E. S. T., release temperature= 8.5° C.

⁴ Instruments released on October 28, 1939, at 0252 E. S. T., release temperature= 1.2° C.

⁵ Instruments released on October 29, 1939, at 0246 E. S. T., release temperature= 10.0° C.

⁶ Instruments released on October 31, 1939, at 0245 E. S. T., release temperature= 0.8° C.

⁷ Instruments released on February 18, 1940, at 0042 E. S. T., release temperature= 0.0° C.

⁸ Instruments released on February 20, 1940, at 0104 E. S. T., release temperature= -1.9° C.

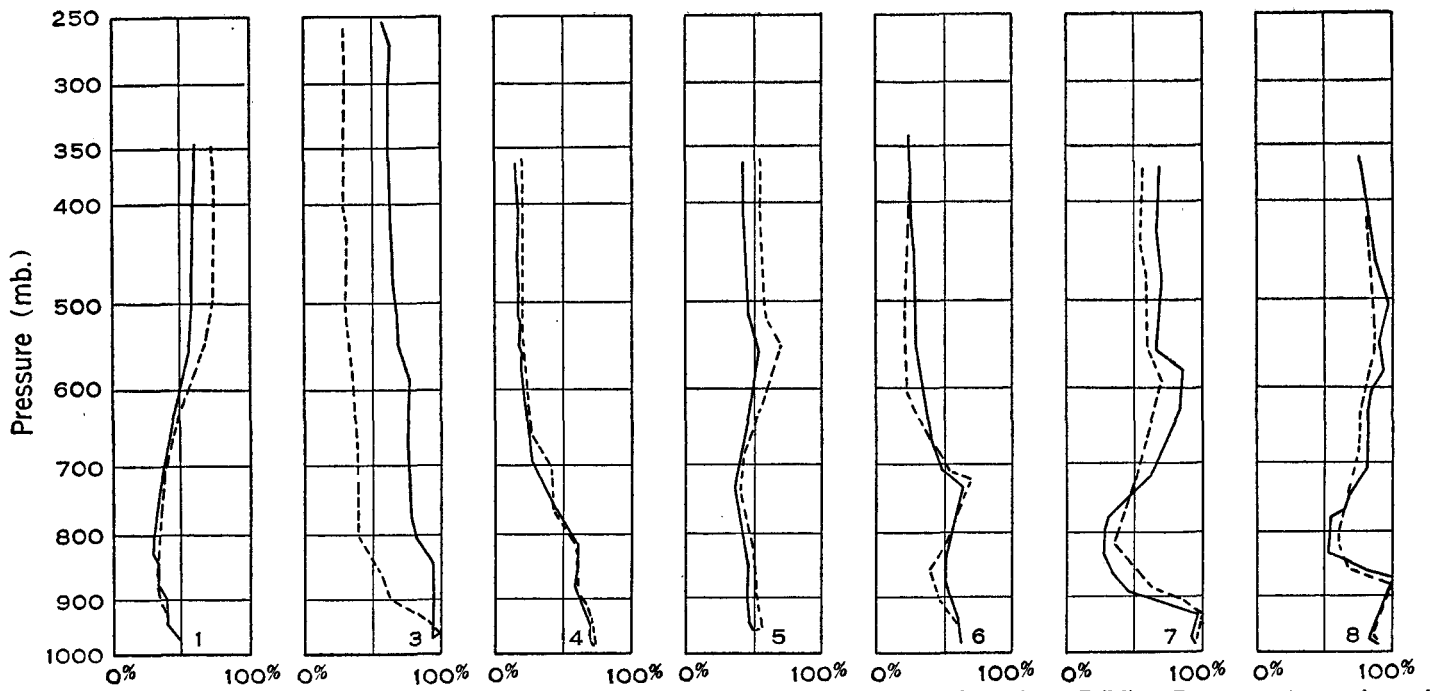


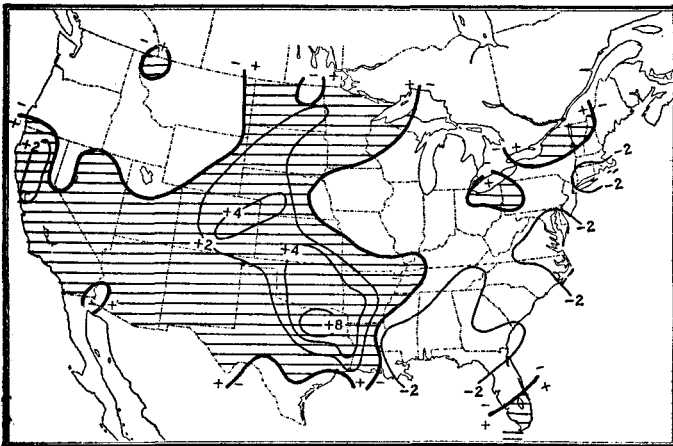
FIGURE 6.—Relative humidity comparisons between the radiosondes and Fergusson meteorographs for selected observations. Full lines, Fergusson meteorograph record; dashed lines, radiosonde record.

NOTE.—Observation numbers correspond to those shown in fig. 5. (No comparison available for observation No. 2.)

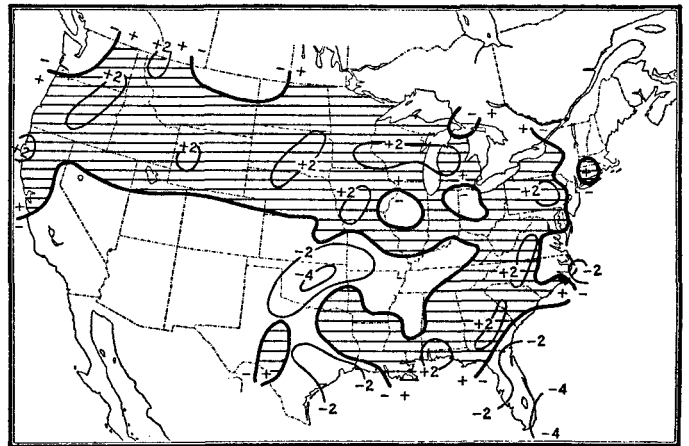
PRECIPITATION DEPARTURES OCTOBER 1941–JULY 1942

The insert map on Climatological Chart No. 5, which shows departures of precipitation from normal, was discontinued beginning with October 1941 and continuing through July 1942. Publication of this inset was renewed beginning with the August issue; and the maps for the intervening months follow.

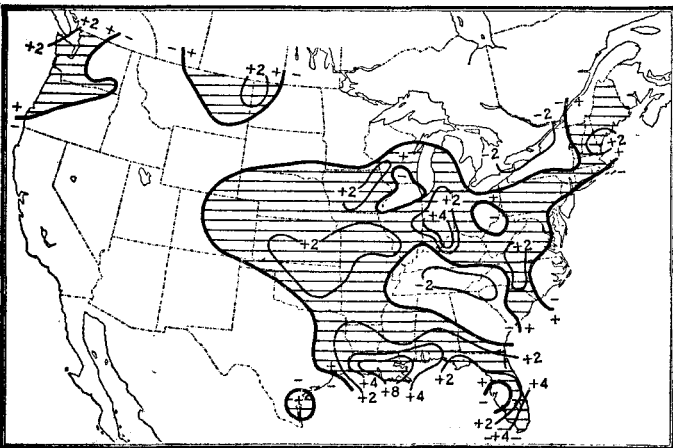
DEPARTURE OF PRECIPITATION FROM THE NORMAL, APRIL, 1942



DEPARTURE OF PRECIPITATION FROM THE NORMAL, MAY, 1942



DEPARTURE OF PRECIPITATION FROM THE NORMAL, JUNE, 1942



DEPARTURE OF PRECIPITATION FROM THE NORMAL, JULY, 1942

